

CLAIMS

I claim:

- 5 1. A method for guiding a medical instrument to a target site within a patient, comprising:
- capturing at least one image during an operation of the patient;
 from a user, receiving an indication of a target site on the captured image;
 based on the indication, determining coordinates of the patient target site in a
10 reference coordinate system;
 determining a position of the instrument in the reference coordinate system;
 projecting onto the display device a field of view from a perspective of the instrument
 in the reference coordinate system; and
 projecting onto the field of view the indicia that specifies the position of the target site
15 relative to the position of the instrument.
2. The method of claim 1, wherein the field of view comprises an image captured
 by the instrument.
3. The method of claim 1, wherein said medical instrument is an endoscope and
 the view field projected onto the display device is the image seen by the endoscope.
- 20 4. The method of claim 1, wherein the view field projected onto the display
 device is that seen from the tip-end position and orientation of the medical instrument having
 a defined field of view.
5. The method of claim 1, wherein the view field projected onto the display
 device seen from a position along the axis of instrument different from the target seen at a
25 tip-end position of the medical instrument.

6. The method of claim 1, wherein the target site is specified as a point, and said indicia are arranged in a geometric pattern indicating a position of a point within the target site.

7. The method of claim 1, wherein the target site is a spatial region within the patient.

8. The method of claim 7, wherein the spatial region has an area, and said indicia are arranged in a geometric pattern defining a boundary of the indicated area.

9. The method of claim 7, wherein the spatial region has a volume, and said indicia are arranged in a geometric pattern defining a boundary of the indicated volume.

10. The method of claim 1, wherein determining the coordinates comprises determining three-dimensional coordinates of the target site in the reference coordinate system.

11. The method of claim 1, wherein the positions of the instrument and the target site are specified by at least two sets of indicia.

12. The method of claim 11, wherein the spacing between indicia is indicative of the distance of the instrument from the target site.

13. The method of claim 11, wherein the size of the individual indicia is indicative of the distance of the instrument from the target site.

14. The method of claim 11, wherein the shape of the individual indicia is indicative of the distance of the instrument from the target site.

15. The method of claim 11, wherein the size of the indicia is indicative of the orientation of said instrument.

16. The method of claim 11, wherein the shape of the indicia is indicative of the orientation of said instrument.

17. The method of claim 1, wherein said indicating includes indicating on each image, a second target site which, together with the first-indicated target site, defines a surgical trajectory on the displayed image.

18. The method of claim 1, which further includes using said instrument to indicate on a patient surface region, an entry point that defines, with said indicated target site, a surgical trajectory on the displayed image.

19. The method of claim 11 or 12, wherein the surgical trajectory on the displayed image is indicated by two sets of indicia, one set corresponding to the first-indicated target site and the second set by the second target site.

20. The method of claim 11 or 12, wherein the surgical trajectory on the displayed image is indicated by a geometric object defined, at its end regions, by the first-indicated target site and the second target site or entry point indicated.

21. The method of claim 1, further comprising moving the instrument toward the target site by moving the instrument so that said indicia are placed or held in a given state in the displayed field of view.

22. The method of claim 1, further comprising determining an orientation of the instrument.

23. A system designed to assist a user to guide a medical instrument to a target site in a patient, the system comprising

(a) an imaging device for generating, during an operation, an image of a patient;

(b) a tracking system for tracking the position of the medical instrument and imaging device in a reference coordinate system,

(c) an indicator for allowing a user to indicate a target site on the image,

(d) a display device,

(e) an electronic computer operably connected to said tracking system, display device, and indicator, and

(f) computer-readable code which is operable, when used to control the operation of the computer, to carry out the steps of

5 (i) recording target-site spatial information indicated by the user on said image(s), through the use of said indicator,

(ii) determining from the spatial information of the target site indicated on said image(s), 3-D coordinates of the target site in a reference coordinate system,

10 (iii) tracking the position of the instrument in the reference coordinate system,

(iv) projecting onto a display device, a view field as seen from a known position of the tool in the reference coordinate system, and

(v) projecting onto the displayed view field, indicia whose states indicate the spatial information of the target site with respect to said known position.

15 24. The system of claim 23, wherein the indicia's states indicate the spatial information of the target site not only with respect to said known position but also with respect to the known orientation of the tool.

25. The system of claim 23, wherein the user, by observing the states of said indicia, can guide the instrument toward the target site by moving the instrument so that said
20 indicia are placed or held in a given state in the displayed field of view.

26. A computer readable medium that stores a computer program that is designed to assist a user in guiding a medical instrument to a target site in a patient, said computer program comprising sets of instructions for:

25 capturing at least one image during an operation of the patient;
from a user, receiving an indication of a target site on the captured image;

based on the indication, determining coordinates of the patient target site in a reference coordinate system;

determining a position of the instrument in the reference coordinate system;

projecting onto the display device a field of view from a perspective of the

5 instrument in the reference coordinate system; and

projecting onto the field of view the indicia that specifies the position of the target site relative to the position of the instrument.